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15 *Part 2* Current electronic commerce systems have two  
salient characteristics. First, they are divided  
primarily along business and application ownership  
lines. The system and application boundaries are  
determined exclusively by the organization that owns  
20 the application or service. The second characteristic  
is that they are built with data control residing in  
physical control. Data belongs to a particular  
business and that business determines its location,  
which is forced accessing applications to choose  
25 between deployment on that same platform or inferior  
performance. The combination of these two factors has  
led to a tightly coupled, monolithic, centralized  
model with a classic two- or three-tiered  
client/server architecture.

30 Today, almost all corporate data is available  
from only one, very large system, and clients must  
submit requests to that system to both update and read  
data. The availability of the central system  
determines the availability of the entire system. The  
35 central system holds all the corporate data and the  
access to it. The present monolithic system is

limited both in terms of availability and scalability. The availability of the central system determines the availability of the entire system. The central system holds all the corporate data and controls the access to it. The scalability of the total system is determined by the scalability of the central system.

Currently existing electronic commerce systems allow for continuously available, but not real-time, status of orders, or continuously available order entry without rapid electronic delivery from open markets. However, no current system maintains a continuously available, scalable order entry system for a business that has rapid electronic delivery from open markets together with real-time order status.

#### SUMMARY OF THE INVENTION

The present invention provides a method of and system for conducting electronic commerce. In the system of the present invention, an enterprise is segmented into a single firm side system, and multiple customer facing and street side systems. The firm side system maintains a single system of record for the enterprise. The firm side system settles orders, maintains customer account balances, and generally maintains the books and records of the enterprise. The firm side system maintains authoritative storage for the books and records of the enterprise. The firm side system has read-only access to data records replicated from the customer facing and street side systems. The system replicates data from the authoritative data storage of the firm side system to read-only storage associated with the customer facing systems and the street side systems.

The customer facing systems provide an interface between the enterprise and the customer for order entry, order status, and account and market

5 The system replicates data records written to the authoritative data storage of any one of the customer facing systems to the authoritative data storage of each of the other customer facing systems. The system also replicates data records written the authoritative data storage of any one of the customer facing systems to the read-only data storage of the firm side system.

15 various markets. Each street side system has  
associated therewith authoritative data storage that  
is written to by the street side system and read-only  
data storage. The system replicates data records  
written to the authoritative data storage of any one  
20 of the street side systems to the authoritative data  
storage of each of the other street side systems and  
to the read-only data storage of each of the customer  
facing systems and firm side system.

25 replicates data records to the authoritative data  
storage of the customer facing systems and the street  
side systems using an insert only/insert always  
strategy, without regard referential integrity and  
data normalization. Each data record is written or  
30 replicated as separate line in the data storage. The  
inquiry application in the customer facing system  
aggregates the data records to determine the true  
state of a transaction.

## BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of a system according to the present invention.

Figure 2 is a diagram of data management and replication according to the present invention.

Figure 3 is a pictorial view illustrating a transaction record format according to the present invention.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and first to FIG. 1, a system according to the present invention is designated generally by the numeral 11. According to the present invention, an enterprise is segmented into a customer facing side 13, a firm side 15, and a street side 17. The system of the present invention finds application to a retail brokerage enterprise.

Customer side 13 is implemented in a plurality of customer side utilities 19. Each customer side utility 19 includes applications for interacting with customers or customers' agents. The applications of the customer side utility 19 include order entry applications and query applications for providing information such as order status, balances, positions, market data, and the like. Customer side utilities 19 are adapted to respond to asynchronous requests from customers received through gateways indicated generally at 21.

Customers can communicate with customer side utilities 19 using customer PC's connected to the Internet using standard Web browser-enabled applications. Customers may also communicate asynchronous requests to customer side utilities 19 through the public switch telephone network using telephones 25. Gateways 21 may communicate with

telephones 25 through voice response units or DTMF-enabled applications. Additionally, customers may communicate with customer side utilities 19 through intermediary retail sales representatives or brokers using personal computers 27 running Web based applications, terminal emulator programs, or the like.

The street side of the system of the present invention is implemented in a plurality of street side utilities 29. In the retail brokerage example of the present invention, street side utilities 29 provide all functionality necessary for executing customer orders. Thus, each street side utility 29 is adapted to communicate asynchronously and diversely through a network indicated generally at 31 with exchanges, indicated generally at 33, mutual fund companies, indicated generally at 35, and the like.

According to the present invention, the firm side of the enterprise is implemented in a firm side utility 37. Firm side utility 37 has access to the authoritative source of data comprising the books and records of the enterprise. Among other things, firm side utility 37 includes applications for settling orders, updating balances, and the like. Firm side utility 37 is adapted to perform end-of-day accounting, bulk processing, and it comprises the source of business intelligence for the enterprise. In the preferred embodiment, firm side utility 37 is implemented using a Geographically Distributed Parallel Sysplex (GDPS) infrastructure available from International Business Machines Corporation. The GDPS system provides failover redundancy to maintain the mission critical records of the firm.

Customer side utilities 19, firm side utility 15, and street side utilities 17 are interconnected for asynchronous communication with each other by a network indicated generally at 39. A customer request

Referring now to FIG. 2, there is shown a block diagram of the data architecture system 11. Each customer side utility 19 has associated therewith customer side writable data storage 41. Customer side writable data 41 has a limited set of data that is updated only by a customer side utility 19. Customer side writable data is authoritative for customer side utilities 19.

20 Data records written to customer side writable  
data 41 are also replicated to customer side  
25 replicated data 43, which is accessible by firm side  
utility 37. Firm side utility 37 uses customer side  
replicated data 43 in its work to settle orders,  
update balances, and the like. Firm side utility 37  
uses customer side replicated data, and other data to  
30 settle orders, update balances, and the like. Firm  
side utility 37 writes the authoritative data of the  
firm to a single firm writable data storage 45. Firm  
writable data 45 is replicated to firm replicated data  
47 associated with each customer side utility 19.  
35 Firm replicated data 47 is read-only by customer side  
utilities 19. Customer side utilities 19 access firm  
replicated data 47, together with customer side  
writable data 41 in order to respond to customer  
inquiries.

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Street side writable data 49 is written to by street side utilities 29 and it comprises the authoritative data for street side utilities 29. Whenever a data record is written to street side writable data 49, that data record is replicated to each street side writable data 49. Additionally, data records written to street side writable data 49 are replicated to street side replicated data 51 associated with firm side utility 37 and street side replicated data 53 associated with customer side utilities 19. Basic street side data associated with order status and execution is made available immediately through replication to customer side utilities 19. Additionally, firm side writable data 45 is replicated to firm replicated data 55 associated with street side utilities 29.

Figure 3 illustrates the format of a transaction data record according to the present invention. Each transaction record includes a transaction identifier or number field 71. Each customer side utility 19 has a unique transaction numbering set or scheme so that the same transaction number is not assigned to more than one transaction. When a customer side utility 19 receives a transaction request from a customer, the receiving customer side utility assigns a transaction number to the transaction. All data records relating to the transaction are identified by the transaction number.

A transaction data record also includes a transaction type field 73, which identifies the type of transaction. In the retail securities environment, examples of transaction types include buy and sell orders. Those skilled in the art will recognize other transaction types, such as limit orders and the like. The status of the transaction is reflected in a status field 75. In the retail securities environment, for

purchase and sale transactions, the status may be placed, canceled, and filled. Status field 75 includes a timestamp, which indicates the time at which the order was placed, canceled, or filled. The timestamp information is used to resolve conflicts. For example an order may be nearly simultaneously canceled and filled. The status change with the earlier timestamp will take precedence over the conflicting status change.

Other information concerning the transaction or status change is contained in an other information field 77. Examples of other information includes the number of shares, the company, and the transaction price.

According to the present invention, data records are written to customer side writable data 41 using an insert-only/insert-always strategy, as opposed to an update strategy, without regard to referential integrity or data normalization. More specifically, each data record is written as a separate row in a database rather than as an update.

The problem with an update strategy is that there must be a record to update. For example, when an order is placed, an order record is created.

Whenever the order's state changes, the order record gets updated. However, in a distributed environment, with asynchronous linkages among systems, state changes may not occur in the anticipated order. An update event may occur or be received at a system without a record to change. The customer may gain access to the system through any of the customer side utilities 19. Accordingly, the customer may not interact with the same customer side utility on each access. Since transactions are processed and data records are replicated at finite speed, there are certain latencies inherent in the system. Also, there

may be periodic failures or interruptions in links over which internal messages are transmitted or data is replicated. Thus, the data associated with a particular customer side utility 19 may not be complete or current.

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Additionally, in current systems, a record that does not exist cannot be changed. Databases enforce constraints of this type through referential integrity. According to referential integrity, there is a relationship between two rows of a database that refer to each other. If the required relationship refers to something that does not exist, the database will not allow the update to occur. According to the present invention, each data record is inserted with regard to referential integrity.

Normalization aims at eliminating duplication of data. Instead of keeping the same data in multiple locations, in current systems the data is defined in one place, then it is referred to from any other place that is related to it. If the system of the present invention used normalized data in the replicated systems, then updates to an order would refer to the original order rather than duplicate that information. Because updates can arrive at different rates, the possibility exists that the original order information may not be there to refer to. Therefore instead of normalizing data, the system of the present invention duplicates information so that each data record carries with it essential information about the order. Thus, the customer side utility 19 can display the order information that it has no matter in which order the data records relating to the order arrive.

According to the present invention, the inquiry applications of customer side utilities 19 contain logic for aggregating the data records with respect to a single transaction to determine the true or best

estimate of the state of the transaction. For example, if the data storage associated with a particular customer side utility contains a data record indicating that an order has been filled, but no data record indicating that the order has been placed, the customer side utility will report that the order has been filled. Similarly, if the data storage contains records indicating that an order has been both filled and canceled, the customer side utility will report that the order has been filled or canceled based upon which event occurred earlier.

It may be seen that the system of the present invention provides improved availability and ensures scalability while retaining flexibility. Because the system of the present invention uses smaller components, and asynchronous links to couple them, the system of the present invention is split into simpler parts that will each be more reliable. In addition, the customer side utilities 19 are continuously available by replication and load balancing among them. Customer side utilities 29 communicate with other parties by diverse routing so that a failure of one system does not stop the flow requests and responses.

Customer side utilities 19 and street side utilities 29 are independently scalable. Because customer side utilities 19 are replicated for availability, they may be scaled by further replicating more systems. The load on the firm side utility 37 is reduced because the inquiry load from customers and the communication with other parties is removed. Therefore, the size of the firm side utility system 37 can be reduced to a sustainable point on the technology curve. The street side systems 29 can be scaled independently and replicated just like the customer side utility systems 19.

From the foregoing, it may be seen that the present invention provides a continuously available, scalable order entry system for a business that has rapid electronic delivery from open markets together with real-time order status. The customer-facing and street-facing parts of the enterprise may be scaled independently to meet increasing volumes of transactions and inquiries. Order state data are replicated across the system so that real-time information is available to the customers.

The present invention has been illustrated and described with respect to presently preferred embodiments. Those skilled in the art will recognize alternative embodiments, given the benefit to the foregoing disclosure. Accordingly, the foregoing disclosure is intended for purposes of illustration rather than limitation.

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